Water Isotope Signature of an Atmospheric River

falling in western Norway

Where is the rain from? We can gain an insight from the observation of stable water isotopes in the rain and water vapor.

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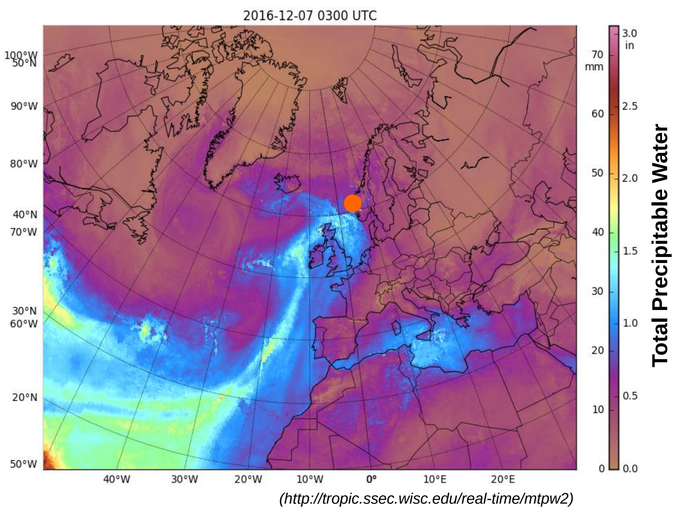
ABSTRACT

The study of atmospheric water cycle is important under the conditon of climate change, since the change of the cycle can affect the distribution of water resources, i.e., causing floods/droughts.

Here we have used the observations of stable water isotopes to gain knowledge of the moisture orgin of a 24h rainfall in Bergen. A shift of moisture origin is identified in both the isotope signature and the moisture source diagnostic model.

Atmospheric river

Relatively narrow regions in the atmosphere that transport water vapor outside of the tropics.

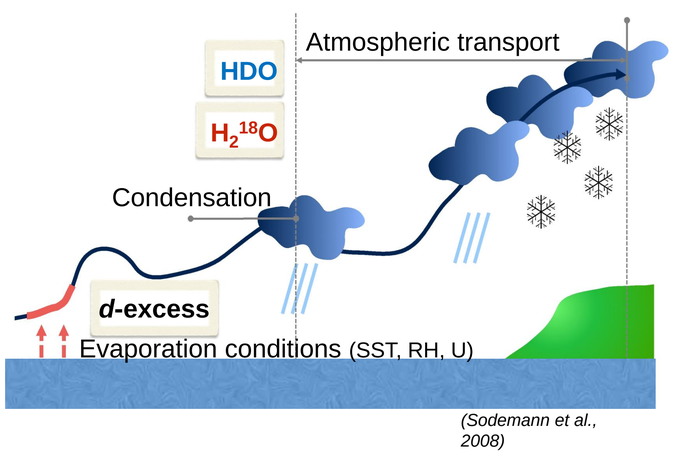


(http://tropic.ssec.wisc.edu/real-time/mtpw2)

Stable water isotopes

Most abundant: $H_2{}^{16}O$, $H_2{}^{18}O$, $HD^{16}O$.
A natural tracer: fractionation influenced by phase changes, dependent on temperature, integrating in time.
δ notation: $\delta = \frac{R_{sample} - R_{standard}}{R_{standard}} \cdot 1000‰$

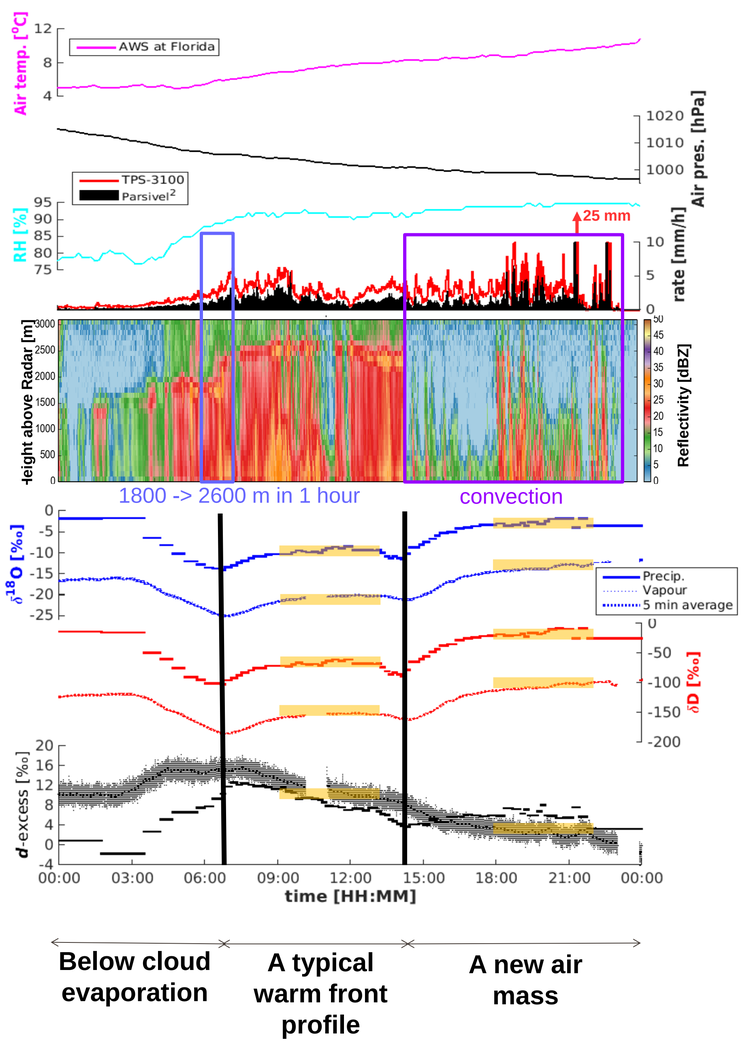
Evaporation indicator: *d*-excess = $\delta D - 8 \cdot \delta^{18}O$

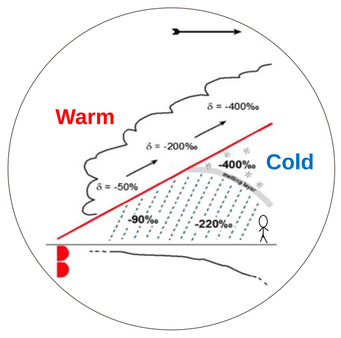


(Sodemann et al., 2008)

Results

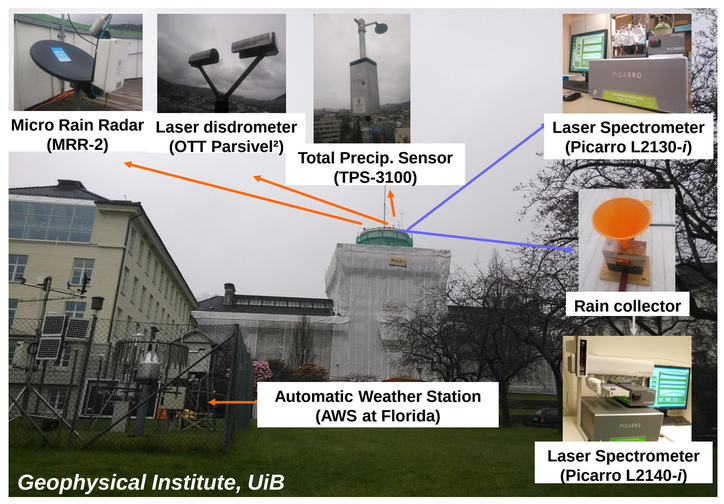
Isotope signature reflects the weather evolution and indicates a shift of moisture origin.





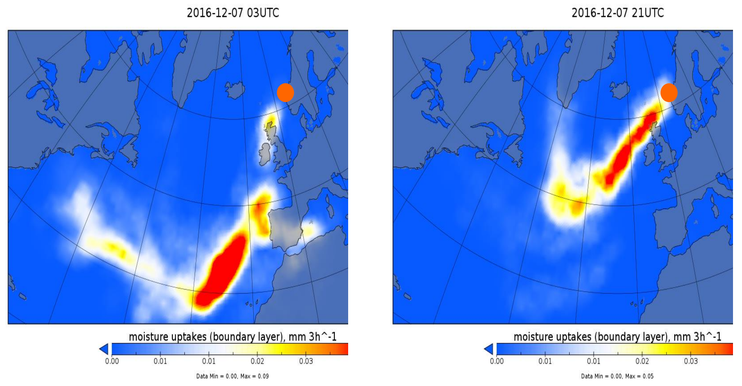
Instrumentation

Weather condition monitoring.
Precip. sampling: 10~20 min, total 40 mm, 72 samples.
Water vapor sampling: 1 sec.



Lagrangian Moisture Source Diagnostic

Lagrangian model: FLEXPAXT, with wind and humidity from ERA-Interim reanalysis.
Diagnostic tool: *Watersip*



Conclusion

→ A unique isotope dataset of atmospheric river in Western Norway.

→ *Below cloud processes* can strongly modify the original isotope signature at the cloud; be careful while interpreting.

→ Change of *moisture origin* is well identified in the isotope signature of precipitation and water vapor. We can use isotope observations to test models related to atmospheric water cycles.

REFERENCES

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